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ORIGINAL ARTICLE

DEVELOPING A USER-CENTERED MOBILE APPLICATION FOR STROKE CAREGIVERS: A PILOT NATIONAL SURVEY

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Abstract: Inadequate support, along with the stroke patient's level of disability, can have a negative impact on informal caregivers' quality of life and well-being. Yet, there is a lack of research and interventions focused on improving the health and well-being of informal caregivers. To determine the most salient potential resources and features for stroke patient caregivers regarding the use of mobile apps to improve caregiver's health. A nationwide survey of caregivers was mailed to stroke survivors through the National Stroke Association, which included questions on demographics, cell phone/smartphone ownership, and caregiver's opinion about mobile app resources– specifically 1) scheduling multiple tasks, 2) finding resource information, 3) finding local resources, 4) tracking fitness and diet, and 5) communication with the stroke survivor. 396 stroke caregivers [(299 (76%) female, 96 (24%) African-American, 42 (11%) Hispanic/Latino, and 210 (53%) Caucasian], aged 20-99 years (mean 58.2 ± 11.30), returned surveys; 96% owned a cell phone and 60% owned a smartphone. Most caregivers reported aspects of the app to be useful, including, doctor/rehab appointments [80% (95% CI 76-84%)], links to reliable medical information [84% (95% CI 80-87%)], local stroke support groups [81% (95% CI 77-85%)], exercises [76% (95% CI 71-80%)], and touch screen with useful phrases [76% (95% CI 71-80%)]. Latino (88%-74%) and African-American (84%-77%) caregivers reported the highest rate of usefulness. Implementation of a mobile app unique to stroke caregivers with multiple resources is desired by this diverse, national sample of informal caregivers. Such a mobile app holds potential to reduce the disparities gap for resource use.

Keywords: Stroke, Caregiver, Rehabilitation, Stroke mHealth, Mobile health

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Introduction

Stroke is one of the leading causes of long-term disability in the United States and is a substantial burden on informal caregivers[1]. These individuals play a vital role in the health and well-being of stroke survivors. Usually, informal caregivers are family members who have little to no training on how to care for a stroke patient. This training deficit creates additional physical, psychological, and economic strain on both the caregiver and patient[1-4].

Inadequate support, along with the stroke patient's level of disability, can have a major negative impact on informal caregivers' quality of life (QoL) and well-being[5]. Yet, there is a lack of research focused on the health and well-being of informal caregivers[1,2,5,6]. New approaches have been reported as possible avenues to improve caregiver QoL including patient and caregiver-centered models[5] and mobile health (mHealth) technology[7]. In 2015, smartphone ownership rates in America were reported as 64%; while 90% owned any type of cell phone, 32% owned an e-reader and 42% owned a tablet computer[8]. Also in 2015, 64% of Latinos and 68% of African Americans owned a cell phone[8]. Numerous studies have shown that Latinos and African Americans have disparate access to healthcare[9,10]. These populations have some of the highest rates of obesity, diabetes, and hypertension – all major risk factors for stroke[10]. New mobile-based technologies may narrow the gap in access to care and health related resources for minority populations[11-13]. To our knowledge, there is no medical app specifically dedicated to stroke patient caregivers to help improve the caregiver's quality of life.

Many resources can be implemented in a mobile app for stroke patient caregivers, which could help both the caregiver and the stroke survivor (e.g. managing task scheduling, finding resources, exercise routines, fitness and diet/nutrition tracking, etc.). In order to design and develop a useful mobile app for stroke patient caregivers, identification of appropriate resources and features for inclusion is critical. A caregiver-centered survey regarding the use of mobile apps was designed to determine the most salient potential resources and features for stroke patient caregivers taking race/ethnicity, age, and gender into account.

Materials and Methods

Design: A nationwide, observational survey. *Participants:* Using a national database of stroke survivors maintained by the National Stroke Association (NSA), stroke survivors were mailed a cover letter and a 17-question survey (Appendix B). The 17 questions were designed by the stroke experts on this manuscript from SUNY Downstate as well National Stroke Association. Stroke survivors were asked to give the survey to their informal caregiver, if applicable. The NSA database does not have a record of how many stroke survivors have caregivers and to our knowledge there are no studies that have determined a ratio of caregivers to stroke survivors. Therefore, it is impossible to conclude response rate. Caregivers were not provided compensation for participating in the study.

Measures: The study was approved by the SUNY Downstate Institutional Review Board. After consent was signed, the survey was administered. The Survey included demographic questions, as well as questions regarding the caregiver's opinion on what features in a mobile app (if any) would be most useful to include, specifically: 1) scheduling multiple tasks, 2) finding information and resources about stroke care on the Internet, 3) local stroke-related resources, 4) tracking fitness and diet, and 5) communication tools for stroke survivors. The caregivers were also surveyed on their ownership of a cell phone and/or smartphone on which the app could be used. *Data Analysis:* Multiple logistic regressions were performed to analyze the data. In the five logistic regression models, the independent variables were age (computed into tertiles 20-53, 54-62, 63-91), race (African American, White, Hispanic/Latino, and responses of Asian, Native American and mixed were grouped as Other), and gender. The dependent variable was overall caregiver rating of the potential usefulness of the app, with regard to the five possible resources, dichotomized as useful or not useful. Responses were coded as "not useful" if they reported, "this app would not be useful" and coded as "useful" if they reported one of the aspects of the mobile app would be useful to help with the given task. Statistical significance was set at .05 and SAS 9.4 (SAS Institute, Inc Cary, NC) was used for statistical analysis.

Results

A sample of 396 informal stroke patient caregivers (299 females) ranging from 20 to 91 years of age participated in this study. The mean age of the caregivers was 58.2 (SD = 11.30) years. Of the 396 caregivers, 210 (53%) were White/Caucasian, 96 (24%) were African-American, 42 (11%) were Hispanic/

Latino, and the remainder (12%) self-identified as Asian, Native American, Mixed and Other. Ninety percent of the caregivers reported owning a cell phone, and 60% of all caregivers reported owning a smartphone.

After examining the five questions to see which resources caregivers want implemented to improve both their and their stroke survivors' lives, high rates of usefulness were found between all races and genders (Tables 1-5). As age increased, caregivers' reports of each resource's potential utility in a mobile app decreased ($p < .05$). However, even in the oldest group (63+), the majority of caregivers reported that each of the five types of resources could be useful in a mobile app, ranging from the lowest at 67% to the highest at 79%. "Doctor or rehab appointments," "Links to trustworthy medical information," "stroke support groups in my or my stroke survivors area," "app with exercises for stroke survivors," and "a touch screen with useful phrases" were reported as potentially the most useful features in a mobile app regardless of race, age, or gender for the five questions.

High rates of potential usefulness were found for the minority caregivers in our sample for these five resources; consequently, each question was investigated further to examine racial differences for each of the five questions individually. Table 1 outlines gender, age, and racial differences for the caregivers' opinions on mobile app features to schedule multiple tasks. Implementation of an app to help caregivers with scheduling multiple tasks for the stroke survivor was found to be useful to 80% (95% CI 76-84%) of the population, with no significant differences found between races when controlling for age and gender ($p = .073$). Caregivers stated that "stroke rehab exercises" and "links to trustworthy medical information" are the most desired features for an app used to find resources about stroke. Table 2 outlines data (App most useful to find information and resources about stroke) based on race, gender, and age, and they were similar between all groups. An app for stroke resources was reported as useful to 84% (95% CI 80-87%) of the caregivers, and no racial differences were found when controlling for age and gender ($p = .89$; Appendix A).

Eighty one percent (95% CI 77-85%) of caregivers believed a mobile app would be useful for finding local resources, and no racial differences were found when controlling for age and gender ($p = .49$; Appendix A). More specifically, caregivers indicated that access to "stroke support groups in my area" and "stroke physicians and rehab specialists in my area" would be most beneficial (Table 3).

	By Race				Age (tertiles)			Gender		
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male	Total %
a. Doctor or rehab appointments	38 (40%)	24 (57%)	77 (37%)	19 (40%)	55 (45%)	58 (47%)	42 (31%)	124 (41%)	33 (35%)	40%
b. Blood pressure tracking	15 (16%)	5 (12%)	21 (10%)	7 (15%)	15 (12%)	13 (10%)	17 (13%)	35 (12%)	13 (14%)	12%
c. A medication reminder	21 (22%)	8 (19%)	42 (20%)	14 (29%)	28 (23%)	25 (20%)	28 (21%)	61 (20%)	22 (24%)	21%
d. Scheduling social activities	4 (4%)	0 (0%)	10 (5%)	0 (0%)	7 (6%)	2 (2%)	5 (4%)	8 (3%)	6 (6%)	4%
e. Coordinating meals with medication schedule	3 (3%)	0 (0%)	8 (4%)	2 (4%)	2 (2%)	5 (4%)	6 (4%)	10 (3%)	2 (2%)	3%
f. This type of app would not be useful	13 (14%)	3 (7%)	47 (22%)	6 (12%)	14 (11%)	21 (17%)	31 (23%)	55 (18%)	14 (15%)	17%
g. User provided no response	2 (2%)	2 (5%)	5 (2%)	0 (0%)	2 (2%)	0 (0%)	7 (5%)	6 (2%)	3 (3%)	2%
Total	96	42	210	48	123	124	136	299	93	

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 1: App most useful when scheduling multiple tasks for stroke survivor

	By Race				Age (tertiles)			Gender		
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male	Total %
a. Suggested stroke rehab exercises	27 (28%)	14 (33%)	65 (31%)	16 (34%)	45 (37%)	40 (32%)	32 (24%)	91 (30%)	29 (31%)	31%
b. Links to trustworthy medical information	27 (28%)	15 (36%)	70 (33%)	14 (29%)	37 (30%)	42 (34%)	44 (32%)	100 (33%)	25 (28%)	32%
c. A medication resource guide	24 (25%)	8 (17%)	39 (19%)	13 (27%)	32 (26%)	19 (15%)	31 (23%)	60 (20%)	23 (24%)	21%
d. This type of app would not be useful	14 (15%)	4 (10%)	28 (13%)	5 (10%)	8 (7%)	19 (15%)	21 (15%)	40 (13%)	11 (12%)	13%
e. User provided no response	4 (4%)	1 (2%)	8 (4%)	0 (0%)	1 (1%)	4 (3%)	8 (6%)	8 (3%)	5 (5%)	3%
Total	96	42	210	48	123	124	136	299	93	

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 2: App most useful to find information and resources about stroke

	By Race				Age (tertiles)			Gender		
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male	Total %
a. Stroke support groups in my or my survivor's area	26 (27%)	13 (31%)	51 (24%)	13 (27%)	32 (26%)	38 (31%)	31 (23%)	74 (25%)	29 (30%)	26%
b. Stroke physicians and rehab specialists in my or my stroke survivor's area	19 (20%)	12 (29%)	51 (24%)	10 (21%)	33 (27%)	29 (23%)	28 (21%)	72 (24%)	20 (20%)	23%
c. Locations of certified stroke centers in my or my stroke survivor's area	14 (15%)	6 (14%)	27 (13%)	11 (23%)	22 (18%)	17 (14%)	17 (13%)	44 (15%)	14 (15%)	15%
d. Reviews of stroke physicians and rehab specialists in my or my stroke survivor's area	14 (15%)	5 (12%)	40 (19%)	9 (19%)	23 (19%)	16 (13%)	24 (18%)	52 (17%)	13 (16%)	17%
e. This type of app would not be useful	18 (19%)	4 (10%)	35(17%)	5 (10%)	11 (9%)	20 (16%)	29 (21%)	50 (17%)	12 (12%)	16%
f. User provided no response	5 (5%)	2 (5%)	6 (3%)	0 (0%)	2 (2%)	4 (3%)	7 (5%)	7 (2%)	6 (6%)	3%
Total	96	42	210	48	123	124	136	299	93	

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 3: App most useful to find local resources

Caregivers reported that having a mobile app with "exercises for stroke survivors" and that "tracks stroke survivor's diet" would be the most beneficial features in an app to track stroke survivors' fitness and diet. However, 21% of the caregivers reported that having an app to track the survivors' fitness and diet would not be useful (Table 4). Caregivers reported that this resource was useful at the lowest percentage of any of the five resources. Racial differences for caregivers' reporting of potential usefulness of an app to track the stroke survivors' fitness and diet, after controlling for age and gender, was not significant ($p = .19$; Appendix A).

	By Race				Age (tertiles)			Gender		
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male	Total %
a. App with exercises for stroke survivors	22 (23%)	11 (26%)	55 (26%)	8 (17%)	32 (26%)	36 (29%)	28 (21%)	74 (25%)	22 (24%)	24%
b. App that tracks stroke survivor's diet	17 (18%)	8 (19%)	35 (17%)	11 (23%)	31 (25%)	15 (12%)	24 (18%)	53 (18%)	17 (19%)	18%
c. App that tracks distance when I or stroke survivor Exercise	12 (13%)	4 (10%)	18 (9%)	6 (13%)	13 (11%)	13 (10%)	11 (8%)	28 (9%)	12 (13%)	10%
d. App that offers healthy meal suggestions for stroke survivors	18 (19%)	7 (17%)	21 (10%)	10 (21%)	21 (17%)	12 (10%)	21 (15%)	44 (15%)	12 (12%)	14%
e. App that tracks how much time I or stroke survivor exercise	8(8%)	5(12%)	21(10%)	3(6%)	8 (7%)	16 (13%)	11 (8%)	29 (10%)	8 (8%)	9%
f. This type of app would not be useful	15 (16%)	6 (14%)	54(26%)	8 (17%)	17 (14%)	31 (25%)	32 (24%)	66 (22%)	16 (17%)	21%
g. User provided no response	4 (4%)	1 (2%)	6 (3%)	2 (4%)	1 (1%)	1 (1%)	9 (7%)	5 (2%)	6 (6%)	3%
Total	96	42	210	48	123	124	136	299	93	

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 4: App most useful to track fitness and diet

The fifth question investigating the most useful features for an app focused on communication with the stroke survivor. Caregivers reported that having a touch screen with useful phrases such as "I am hungry" would be the most useful. However, 21% of the caregivers reported that an app to communicate with the stroke survivor would not be useful (Table 5). Racial and gender differences were not found when investigating caregivers' opinions on usefulness of an app to help the caregiver communicate with stroke survivors (p =.67; Appendix A).

Discussion

To our knowledge, this study is the first to formally investigate a national sampling of informal stroke caregivers' opinions on potential usefulness of features to be made available in a mobile stroke app. Despite the millions of informal caregivers who suffer economic, physical and emotional burdens[14], there are limited resources that are both useful and cost effective. Forty percent of caregivers reported having an app for "doctor or rehab appointments" as potentially the most useful, which is consistent with stroke patients often having multiple health care providers, including neurologists, cardiologists, primary care physicians, physical therapists and/or speech therapists. Tracking numerous appointments and ensuring that these are kept can become challenging and increase stress, especially when coordinating with existing commitments. Therefore, implementing a mobile app that assists caregivers in organizing the stroke survivor's schedule could alleviate some of the caretaker's burden.

Caregivers' QoL and well-being have been found to be associated with the disability level of the stroke survivors[5], and providing a tool to help manage the severity of survivor's disability may help improve the caregiver's QoL and well-being. Moreover, by improving caregivers QoL, it may in turn improve the survivor's QoL and well-being. Caregivers reported that an app which would provide "links to trustworthy medical information," "exercises for stroke survivors," "stroke support groups in my or survivor's area," and "stroke physicians and rehab specialists in my or survivor's area," would be the most useful. Creating an app that would provide caregivers with this information might not only improve stroke survivors' QoL and well-being, but potentially improve the caregiver's health by

	By Race				Age (tertiles)			Gender		
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male	Total %
a. An app that uses GPS to show my stroke survivor's location	19 (20%)	9 (21%)	36 (17%)	8 (17%)	25 (20%)	22 (18%)	21 (15%)	60 (20%)	12 (12%)	18%
b. An app that my stroke survivor can show people to let them know they have had a stroke	6 (6%)	3 (7%)	29 (14%)	2 (4%)	10 (8%)	13 (10%)	16 (12%)	27 (9%)	13 (13%)	10%
c. A touch screen with useful phrases (e.g. I am hungry)	33 (34%)	15 (36%)	58 (28%)	19 (40%)	46 (37%)	38 (31%)	39 (29%)	96 (32%)	26 (29%)	32%
d. An app that translates text messages your stroke survivor received to spoken words	10 (10%)	2 (5%)	17 (8%)	3 (6%)	9 (7%)	13 (10%)	10 (7%)	26 (9%)	6 (6%)	8%
e. An app that translates stroke survivor's typed text into spoken words	5(5%)	2(5%)	15(7%)	7(15%)	15 (12%)	6 (5%)	8 (6%)	19 (6%)	10 (10%)	7%
f. This type of app would not Be useful	21 (22%)	10 (24%)	47(22%)	7 (15%)	16 (13%)	31 (25%)	34 (25%)	66 (22%)	17 (20%)	21%
g. User provided no response	2 (2%)	1 (2%)	8 (4%)	2 (4%)	2 (2%)	1 (1%)	8 (6%)	5 (2%)	6 (9%)	3%
Total	96	42	210	48	123	124	136	299	93	

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 5: App most useful for Stroke Survivor to communicate with you

allowing the caregiver opportunities to exercise with the patient or bring the stroke survivor to support groups. In turn, these activities could reduce caregivers' feelings of alienation and stress[5]. Also, many of these apps hold the potential to decrease economic burden if a caregiver is given resources that will improve recovery for the stroke patient, thereby reducing the number of practitioners or appointments required for future care. Evaluating resources for stroke patients and their caregivers is important following a stroke, and especially for minority groups who may have limited or no access to healthcare[9,10].

One of the objectives of this study was to examine racial/ethnic differences in caregivers' assessment of the potential utility of a mobile app, and to identify specific features caregivers would want in a mobile app. Despite not finding any significant differences among races/ethnicities for all five questions regarding desirable features, possibly due to an underpowered sample, Hispanic/Latino and African American respondents reported the highest rates of potential utility for all five-resource types. Minority populations also have highest rates of poverty and are often underserved[15], so reducing the economic burden on these caregivers is critical. Therefore, implementation of a mobile app with the features desired by the minority informal caregivers in this sample may narrow the gap by providing resources that will improve health outcomes for minority populations.

Mobile technology was not available until later in the lives of older adults. As expected, the five resources of the mobile app were reported as potentially less useful for the older cohort, as compared to a younger sample[16]. However, in our oldest group of 63+ years of age, more than half of caregivers reported all five resources could be useful in a mobile app. The argument against mHealth technology for caregivers[15,17] has been that older generations will not have access to, or benefit from, these

resources in a mobile app. However, high rates of cellphone/smartphone ownership among older participants (63+; cell phone ownership= 86%, smartphone ownership= 43%) were reported, and this older cohort reported that the resources could be potentially useful. Despite arguments stating that older adults wouldn't benefit from mHealth[15], our data suggest that mHealth has the potential to be an innovative, universal resource accessible to all populations.

There were several limitations in this study. First, the study was survey-based from a national database and the respondents may not necessarily be representative of the general stroke caregiver population. Also, the response rate is impossible to identify due to the NSA not having records of how many stroke survivors had caregivers. Although the app resources and features selected for the survey were developed with input from two focus groups of stroke survivors[18], the questionnaire did not allow for open-ended responses. Therefore, it could be argued that caregivers in the sample may desire alternative features built into a mobile app, which were not captured by the closed-ended questionnaire. Another potential weakness is that we do not know the symptoms of the caregivers' stroke survivors' strokes or their concurrent illnesses. These items could have impacted the responses of the respondents (e.g. survivors with/without aphasia may or may not need communication tools; survivors with diabetes or hypertension may need more diet tools than those without).

Conclusion

Despite these limitations, at least 80% of caregivers said they want these features in a mobile app, which provides a foundation for future app/studies to build upon. Future directions for research that may benefit the field and improve both stroke patient and caregivers health and well-being are, developing a mobile app for caregivers, and completing beta testing to make sure it meets the needs of the caregivers, is user friendly, and can be disseminated to all races, ethnicities and age groups.

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Conflict of interest

There is no conflict of interest in this research.

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Appendix A

	By Race				Age (tertiles)			Gender	
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male
a. YES	81 (84%)	37 (88%)	158 (75%)	42 (88%)	107 (87%)	103 (83%)	98 (72%)	238 (80%)	76 (82%)
b. No	13 (14%)	3 (7%)	47 (22%)	6 (12%)	14 (11%)	21 (17%)	31 (23%)	55 (18%)	14 (15%)
g. User provided no response	2 (2%)	2 (5%)	5 (2%)	0 (0%)	2(1%)	0 (0%)	7 (5%)	6 (2%)	3 (3%)
Total	96	42	210	48	123	124	136	299	93

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 1a: App most useful when scheduling multiple tasks for stroke survivor (Dichotomized)

	By Race				Age (tertiles)			Gender	
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male
a. Yes	78 (81%)	37 (88%)	174 (83%)	43 (90%)	114 (92%)	101 (81%)	107 (79%)	251 (84%)	77 (83%)
b. No	14 (15%)	4 (10%)	28 (13%)	5 (10%)	8 (7%)	19 (15%)	21 (15%)	40 (13%)	11 (12%)
c. User provided no response	4 (4%)	1(2%)	8 (4%)	0 (0%)	1 (1%)	4 (3%)	8 (5%)	8 (3%)	5 (5%)
Total	96	42	210	48	123	124	136	299	93

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 2a: App most useful to find information and resources about stroke (Dichotomized)

	Three Races				Age (tertiles)			Gender	
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male
a. Yes	74 (77%)	37 (88%)	167 (80%)	43 (90%)	111 (91%)	100 (80%)	99 (72%)	241 (80%)	80 (82%)
b. No	18 (19%)	4 (10%)	35(17%)	5 (10%)	11 (9%)	20 (16%)	29 (21%)	50 (17%)	12 (13%)
c. User provided no response	4 (4%)	1(2%)	8 (4%)	0 (0%)	1 (1%)	4 (3%)	8 6%)	8 (3%)	5 (5%)
Total	96	42	210	48	123	124	136	299	93

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 3a: App most useful to find local resources (Dichotomized)

	By Race				Age (tertiles)			Gender	
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male
a. Yes	77 (80%)	35 (84%)	150 (71%)	38 (79%)	105 (85%)	93 (74%)	90 (66%)	128 (76%)	68 (73%)
b. No	15 (16%)	6 (14%)	54(26%)	8 (17%)	17 (14%)	31 (25%)	35 (26%)	66 (22%)	17 (18%)
c. User provided no response	4 (4%)	1 (2%)	6 (3%)	2 (4%)	1 (1%)	1 (1%)	11 (8%)	5 (2%)	8 (9%)
Total	96	42	210	48	123	124	136	299	93

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 4a: App most useful to track fitness and diet (Dichotomized)

	By Race				Age (tertiles)			Gender	
	AA	H/L	W/C	Other	20-53	54-62	63+	Female	Male
a. Yes	73 (76%)	31 (74%)	155 (74%)	39 (79%)	105 (85%)	92 (73%)	94 (69%)	228 (76%)	66 (73%)
b. No	21 (22%)	10 (24%)	47(22%)	7 (17%)	16 (13%)	31 (25%)	34 (25%)	66 (22%)	19 (20%)
c. User provided no response	2 (2%)	1 (2%)	8 (4%)	2 (4%)	2 (2%)	1 (2%)	8 (6%)	5 (2%)	8 (9%)
Total	96	42	210	48	123	124	136	299	93

AA=African American, H/L=Hispanic/Latino, W/C=White/Caucasian, Other= All other races

Table 5a: App most useful for Stroke Survivor to communicate with you (Dichotomized)

Appendix B

Ten questions mailed to stroke caregivers and analyzed in this study

1. Which of these mobile apps would be the MOST useful to you when scheduling your stroke survivor's multiple tasks? *(**Please check only one**)*
   a. Doctor or rehab appointments
   b. A medication reminder
   c. Coordinating meals with medication schedule
   d. Scheduling social activities
   e. Blood pressure tracking
   f. This type of app would not be useful

2. Which of these mobile apps would be the MOST useful to help you find how-to information about stroke care on the Internet? (***Please check only one***)
   a. A medication resource guide
   b. Suggested stroke rehab exercises
   c. Links to trustworthy medical information
   d. This type of app would not be useful

3. Which of these mobile apps would be the MOST useful to help you find LOCAL stroke-related resources? *(**Please check only one**)*
   a. Stroke support groups in my or my stroke survivor's area
   b. Stroke physicians and rehab specialists in my or my stroke survivor's area
   c. Reviews of stroke physicians and rehab specialists in my or my stroke survivor's area
   d. Locations of certified stroke centers in my or my stroke survivor's area
   e. This type of app would not be useful

4. Which of these mobile apps would be the MOST useful to you to track your stroke survivor's fitness and diet? (***Please check only one***)
   a. An app that tracks distance when I or my stroke survivor exercise
   b. An app that tracks how much time I or my stroke survivor exercise
   c. An app with exercises for stroke survivors
   d. An app that offers healthy meal suggestions for stroke survivors
   e. An app that tracks my stroke survivor's diet, including calories, sodium, fat, etc.
   f. This type of app would not be useful

5. Which of these mobile apps would be the MOST useful to your stroke survivor to communicate with you and/or others? *(**Please check one**)*
   a. A touch screen with useful phrases (e.g., I want to go to the park; I am hungry)
   b. An app that translates your stroke survivor's typed text into spoken words
   c. An app that translates a text message your stroke survivor receives into spoken words
   d. An app that my stroke survivor can show people to let them know they have had a stroke
   e. An app that uses GPS to show my stroke survivor's location
   f. This type of app would not be useful

6. Please check if you are:
   ___ female ___ male

7. What is your age? _____

8. Please check the ethnicity that best describes you:
   ___ Black or African-American
   ___ Afro-Caribbean
   ___ White or Caucasian
   ___ Hispanic or Latino
   ___ Asian
   ___ Native American
   ___ Mixed
   ___ Other

9. Do you have a cell phone?
   ___ Yes ___ No

10. If Yes, is your cell phone a smartphone (i.e., you can use it to connect to the Internet or web)?
    ___ Yes ___ No